

## CLAIMS

1. A refrigeration system comprising a cryopump, a cryopump housing having a cryopump inlet in the housing, at least one cryopanel, at least one pulse tube and at least one regenerator where the pulse tubes and regenerators are located in a common plane in the center of the cryopump housing and a surface of the last stage cryopanel lies in a plane such that a line can be drawn on a cryopanel surface that is parallel to the line where the plane of the tubes intersects the inlet plane.

2. A refrigeration system comprising a cryopump, a cryopump housing having a cryopump inlet in the housing, at least one cryopanel, at least one pulse tube, at least one regenerator and a pulse tube valve assembly where the pulse tubes and regenerators are located in a common plane in the center of the cryopump housing and a surface of the last stage cryopanel lies in a plane that intersects the plane with the tubes pitched parallel to the coldest pulse tube.

3. The refrigeration system of claim 2 having more than one pulse tube.

4. The refrigeration system of claim 2 having more than one regenerator.

5. The refrigeration system of claim 2 having two pulse tubes and at least one regenerator.

6. The refrigeration system of claim 2 where a first stage pulse tube is located between the cryopump inlet and a second stage pulse tube and the pulse tube valve assembly is located below the cryopump housing or at the side of the cryopump opposite the cryopump inlet.

7. The refrigeration system of claim 6 where the valve assembly is located at the side of the cryopump housing opposite the cryopump inlet.

8. The refrigeration system of claim 6 where the valve assembly is located below the cryopump housing.

9. The refrigeration system of claim 2 where a second stage pulse tube is located between the cryopump inlet and a first stage pulse tube and the pulse tube valve assembly

is located below the cryopump housing or at the side of the cryopump opposite the cryopump inlet.

10. The refrigeration system of claim 9 where the valve assembly is located at the side of the cryopump housing opposite the cryopump inlet.

11. The refrigeration system of claim 9 where the valve assembly is located below the cryopump housing.

12. The refrigeration system of claim 2 also comprising a thermal bus.

13. The refrigeration system of claim 12 where the thermal bus is parallel to the pulse tube positioned closest to the cryopump inlet.

14. The refrigeration system of claim 2 also comprising a buffer volume where the hot ends of the pulse tubes are integral to the cryopump housing and the buffer volume is external to the housing.

15. The refrigeration system of claim 2 where the cryopump housing is generally cylindrical in shape, has a horizontal centerline and has an inlet on the end of the housing.

16. The refrigeration system of claim 2 where the second stage cryopanel is flat plates folded over with different pitches.

17. The refrigeration system of claim 16 where the second stage cryopanel is attached to the cold station of the second stage regenerator.

18. A refrigeration system comprising a cryopump, a cryopump housing having a cryopump inlet in the housing, at least one cryopanel, at least one pulse tube and at least one regenerator where the pulse tubes and regenerators are located in a common plane in the center of the cryopump housing and a surface of the last stage cryopanel lies in a plane that intersects the plane with the tubes parallel to the coldest pulse tube.